OEM Design Guide

Philips T5 VHO and HO Extreme Temperature Lamps and Ballasts

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1. General information on the Philips T5 VHO and HO Extreme Temperature system

1.1. Introduction

Philips T5 VHO and HO Extreme Temperature are fluorescent lamps with a diameter of about 0.63 in with the latest technologies incorporated. These T5 VHO (Very High Output) and HO (High Output) Extreme Temperature lamps have temperature optimized performance and have a high lumen output in a very broad temperature range (65–170°F). This performance is achieved by adding an amalgam to the lamp. Furthermore, two auxiliary amalgams are used for a faster system run-up.

Philips T5 VHO Extreme Temperature lamps are especially designed for mid-bay and high-bay applications with typical mounting heights of 16 feet and above, such as factories, sports arenas, train stations, warehouses, airports, and many more. The advantages of fluorescent lighting in these applications are good light distribution, beam control, instant hot restrike, long life, dimmability and low maintenance costs. They are also well suited for compact and indirect lighting fixtures where ambient temperature is a critical element.

Philips T5 HO Extreme Temperature lamps are especially designed for cold and warm applications, such as coolers, outdoor luminaires, unconditioned warehouses, compact luminaires (e.g. wall washers) or hot factory environments. The lamps can be used in luminaires where currently the same types with cold spot technology are used.

Philips T5 VHO and HO Extreme Temperature lamps are designed for operation with high frequency electronic ballasts for maximum efficacy.

The Philips T5 Extreme Temperature range consists of the following types:

T5 VHO 95W Extreme Temperature (46 in)
T5 HO 54W Extreme Temperature (46 in)

They are available in the color temperatures 835 and 841.

Features of Philips T5 VHO and HO Extreme Temperature ranges

The lamps have the following characteristics:

- A high initial lumen output of approximately 7,200 lumens for the VHO lamps
- A lumen output of more than 90% of the maximum lumen output between 65°F and 170°F (lamp ambient temperature) due to amalgam technology
- A fairly constant lumen level during lamp life due to a tri-phosphor layer in combination with new coating technologies
- Narrow lamp diameter of about 0.63 inches
- Good color rendering (85 CRI)
- Rated average life of 25,000 burning hours at a 3 hr switching cycle
- Rated average life of 35,000 burning hours at a 12 hr switching cycle
- Low mercury
- To secure an optimal and hassle free operation, T5 VHO lamps have a lamp cap with flattened pins which only fit into Gx5 lamp holders

1.2. Optimum operation of T5 lamps with amalgam technology

The luminous flux of a low-pressure mercury lamp is determined by the mercury vapor pressure in the lamp. In an amalgam lamp, the mercury vapor pressure is determined by the amalgam itself and not by the coldest spot in the lamp as with regular Philips T5 HE and HO lamps. An amalgam is an alloy of mercury and other metal(s) and ensures a near-constant mercury pressure over a wide temperature range. As a result of that, the lumen output is more than 90% of the maximum lumen output between 65°F and 170°F.

2. Luminaire design

2.1. International Electrotechnical Commission (IEC) Recommendations

The general recommendations for luminaire design by IEC are also applicable to T5 luminaires. Lamp-related data can be found in IEC Standards 61195 for safety and 60081 for performance.

2.2. Operating temperatures T5 VHO and HO Extreme Temperature lamps

2.2.1. Lamp temperatures

The data on the T5 lamps are based on free burning conditions in a reference circuitry and the lamp should also be tested in that way, unless stated otherwise.

2.2.2. Maximum temperatures of lamp parts

Luminaires for T5 lamps must satisfy the general requirements for luminaires as specified by IEC 60598 and, if applicable, comply with the requirements of local standards. The maximum allowed temperature of the lamp cap is 248°F, as given in IEC 61195—Double capped fluorescent lamps—Safety specifications.

2.2.3. Measuring the lamp cap for optimum lamp conditions

In comparison with cold spot mercury lamps, the relation between light output and cap temperature is less direct with amalgam lamps. Over a broad temperature range the light output is at a very high level.

2.3. General recommendations for handling and measuring T5 lamps and luminaires

2.3.1. Handling

Handling of T5 VHO and HO Extreme Temperature lamps is less critical than the handling of T5 HE/HO lamps with cold-spot technology. It is recommended to handle the lamps in a vertical position with the stamp at the lowest side.

Allow the T5 Extreme Temperature VHO and HO lamps to cool down for 10 minutes before handling.

2.3.2. Measuring luminaires for T5 lamps

Before measuring the light output ratio of a luminaire, the T5 Extreme Temperature lamps should be in a stable condition. The following steps must be taken:

- To bring the lamps to a stable condition, operate the lamps for approximately 100 hours
- Wait for 12 hours with the lamps turned off
- Measure the top lumen output of the lamps in the photometer with a measurement time of approximately 15 minutes
- For measuring the total Phi-T curve, a temperature step of 1°F/hr must be applied, starting at a low temperature and going to a high temperature

2.4. Thermal luminaire design and ballast lifetime

The ballasts for T5 VHO and T5 HO have a T_case max of 194°F (90°C). To maximize the lifetime and to minimize the failure rate of the ballast, the ballast should be placed inside the luminaire at a point where the measured T_case is lowest.

The time after which 10% of the ballasts have failed is called the constant failure rate. For a T5 VHO and HO ballast in normal operation, this constant failure rate is approximately 50,000 hours at a fixed specified case temperature (194°F). A temperature increase of approximately 18°F halves this lifetime (thus, 212°F gives 25,000 hrs), while approximately 18°F lower doubles this figure (176°F gives 100,000 hrs).

2.4.1. Thermal hints and tips

There is an increasing trend towards higher wattages and lumen outputs in fluorescent lighting, leading to higher internal temperatures of luminaires.

Every luminaire is different (difference in materials, dimensions, applications, requirements, etc) so there is not just one simple solution which helps to prevent overheating of the internal luminaire. These hints and tips provide some ideas on how to deal with heat management inside a luminaire.

In the case of T5 VHO, the minimum distance between the lamp and the reflector must be at least 10mm. Adapting existing T5 luminaires (<54W) for T5 VHO requires more adjustment than just changing the lamp holders and ballasts.

2.5. Luminaire design and EMI performance

The degree of electromagnetic compatibility (EMC) is basically determined by the high frequency ballast concept in combination with the luminaire design. Taking the following basic rules into consideration will optimize the EMC behavior of the system and help to fulfill the requirements. The basic rules are valid for both PL and TL applications where functional and/or protective ground is required. Functional ground can be required in order to fulfill the EMC requirements or to guarantee proper operation of the system. It means that an ignition aid or other metal surfaces are necessary, which should be connected electrically to the housing of the ballast.

1. Ensure a firm electrical connection between the ballast and the metal luminaire. The contact resistance has to be as small as possible, so affix the ballast directly to the luminaire. The use of additional mounting plates or several junctions has a negative influence on EMC.
2. Keep the lamp wiring short. Avoid redundant wiring, e.g. loops. The so-called 'hot' wires should be the shortest and have the same (symmetrical) length for two lamp ballasts.
3. Keep the mains wiring far away from lamp wiring. Ensure that the mains wiring inside the luminaire is as short as possible. Minimize stray capacitance by ensuring that mains wiring does not run parallel to lamp wiring.
4. Provide good electrical contact between the metal luminaire and reflector and/or louver.
5. Use a shielding around the lamp, well connected to the luminaire. This will help to reduce surrounding currents.
6. Minimize capacitance between wires and the luminaire. If possible, mount the lamp wiring on spacers. Do not group wires by means of tie wraps.

For more examples and background information visit:
www.advancetransformer.com

2.6. Lamp holder / cap

Lamp holders and wiring for T5 lamps should be the 500V rated versions.

T5 VHO Extreme Temperature lamps have flattened pins for use in combination with Gx5 lamp holders. T5 lamps with round pins will not fit into the Gx5 lamp holders. The Gx5 lamp holders have a small plastic part on the top which prevents the insertion of lamps with round pins.

The following distances between lampholders in the luminaire must be used:

T5 VHO 95W Extreme Temperature (46 in)	
Minimum distance	45.24 in
Maximum distance	45.29 in

The Gx5 lamp holder can be mounted in the same way as G5 lamp holders. In case you are using automatic checking equipment of the wiring with automatic probes inserted in the top of the lamp holder, this operation is unfortunately no longer possible as the holes are used for the plastic insert of the Gx5 lamp holders.

The existing lamp holders for G5 capped lamps are suitable up to 250 volts, which means that the applied voltage must be lower than 250 volts towards the ground. As T5 lamps are especially designed for operation with the high frequency ballasts the voltage may exceed 250 volts under dimming conditions.

Several lamp holder manufacturers have G5 lamp holders in their range that are marked 500V, which means that voltages up to 500 volts towards the ground are allowed.

In general, all requirements relating to G5 type lamp holders will be summarized in IEC 60061-2, 60061-4 and 400.

3. T5 VHO and HO Extreme Temperature lamp specifications

3.1. Product offerings

The T5 Extreme Temperature range consists of the following types:

T5 VHO 95W Extreme Temperature (46 in)
T5 HO 54W Extreme Temperature (46 in)

3.2. Mechanical characteristics

The lamps fulfill the safety regulations found in IEC 61195 — Double-capped fluorescent lamps—Safety specifications.
The nominal diameter of T5 lamps is 0.63 in; the maximum lamp outline (including the bending) is 0.67 in.

3.3. T5 VHO and HO Extreme Temperature publication values

T5 Extreme Temperature lamps are amalgam lamps with a very broad temperature range. The lumen output is above 90% of the maximum lumen output between 65°F and 170 °F. In table 3.1. the nominal values are given.

Lamp type	Color	Lamp Voltage (V)	Discharge Current (A)	Resistance	Lamp power (W)	Luminous flux (lm)
T5 VHO 95W Extreme Temperature	835 / 841	123	800 mA	154	95	7200
T5 HO 54W Extreme Temperature	835 / 841	118	460 mA	255	54	5000

Lamp type	Color	Lamp Power (W)	Luminous flux (lm)	Luminous efficacy (lm/W)	Luminance cd/cm
T5 VHO 95W Extreme Temperature	835 / 841	95	7200	76	$4.4 \cdot 10^4$
T5 HO 54W Extreme Temperature	835 / 841	54	5000	93	$2.9 \cdot 10^4$

Table 3.1. Electrical and photometrical data of T5 VHO and HO Extreme Temperature lamps
Note: All data after 100 operating hours

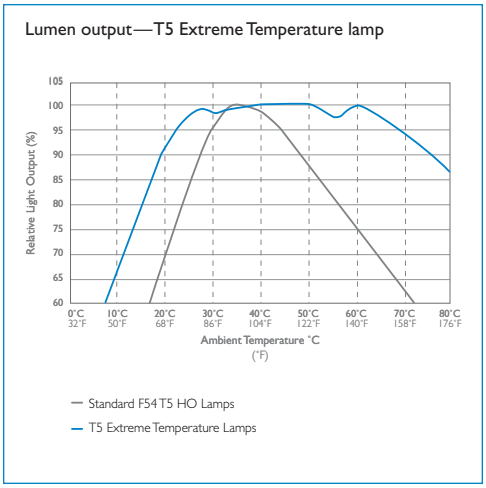


Figure 3.1. Relative light output of a T5 Extreme Temperature lamp in relation to the lamp ambient temperature

Lumen output curves

In figure 3.1., the relative light output of a typical T5 Extreme Temperature lamp in relation to the lamp ambient temperature is shown. The light output is more than 90% between 65°F and 170°F.

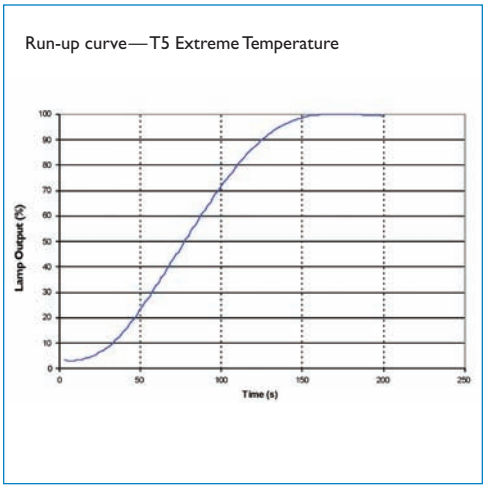


Figure 3.2. Typical run-up curve of a T5 Extreme Temperature lamp

Run-up curves

In order to secure a fast run-up of the lamps, they are equipped with auxiliary amalgams at both ends of the lamp. The auxiliary amalgam increases the mercury vapor pressure after ignition of the lamp. Within 3 minutes the lamp will reach 80% of its final output. In figure 3.2. a typical run-up curve of a T5 Extreme Temperature lamp is shown.

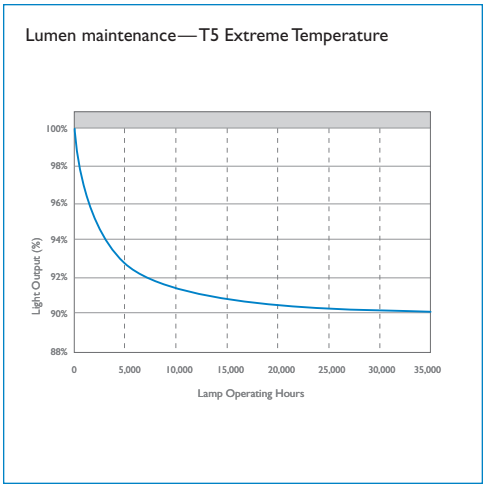


Figure 3.3. Lumen maintenance of T5 Extreme Temperature lamps

Lumen maintenance

The lumen maintenance of T5 Extreme Temperature lamps will be at 90% at 40% of rated average life. See figure 3.3.

4. Ballast specification for T5 VHO and HO Extreme Temperature lamps

4.1. First start-up

During the first start-up of the lamps, the lamps will have a reddish/pinkish color in the middle of them. This effect is related to the mercury distribution throughout the lamp and will disappear within 2–3 minutes.

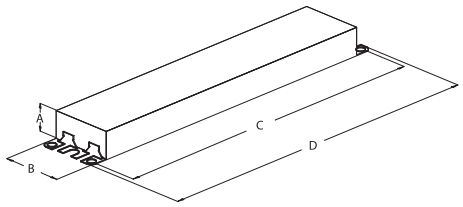
4.2. Ballast ordering, electrical and technical data

No. of Lamps	Input Volts	Lamp Starting Method	Catalog Number	Maximum Input Power ANSI (Watts)	Maximum Ballast Factor	Line Current (Amps)	Min. Starting Temp (°F/°C)
T5 VHO							
1	277	PS	JOP-2S95-G	116W	1.1	0.42	-19/-28
1	347	PS	JOP-2S95-G	116W	1.1	0.35	-19/-28
1	480	PS	JOP-2S95-G	116W	1.1	0.24	-19/-28
2	277	PS	JOP-2S95-G	206W	1.0	0.74	-19/-28
2	347	PS	JOP-2S95-G	206W	1.0	0.59	-19/-28
2	480	PS	JOP-2S95-G	206W	1.0	0.43	-19/-28
T5 HO							
1	120	PS	ICN2S5490CWL	62W	1.0	0.52	-20/-29
1	277	PS	ICN2S5490CWL	62W	1.0	0.23	-20/-29
2	120	PS	ICN2S5490CWL	120W	1.0	1.00	-20/-29
2	277	PS	ICN2S5490CWL	117W	1.0	0.43	-20/-29
1	347	PS	HCN2S5490CWL	62W	1.0	0.18	-20/-29
1	480	PS	HCN2S5490CWL	62W	1.0	0.13	-20/-29
2	347	PS	HCN2S5490CWL	120W	1.0	0.35	-20/-29
2	480	PS	HCN2S5490CWL	119W	1.0	0.25	-20/-29
3	120	PS	ICN4S5490C2LSG	182W	1.0	1.52	-20/-29
3	277	PS	ICN4S5490C2LSG	179W	1.0	0.66	-20/-29
4	120	PS	ICN4S5490C2LSG	240W	1.0	2.00	-20/-29
4	277	PS	ICN4S5490C2LSG	234W	1.0	0.86	-20/-29
3	347	PS	HCN4S5490C2LSG	188W	1.0	0.54	-20/-29
3	480	PS	HCN4S5490C2LSG	186W	1.0	0.39	-20/-29
4	347	PS	HCN4S5490C2LSG	239W	1.0	0.69	-20/-29
4	480	PS	HCN4S5490C2LSG	237W	1.0	0.50	-20/-29

Above specifications subject to change without notice.

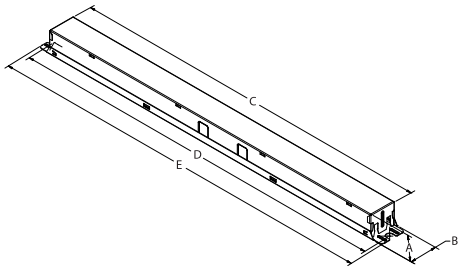
4.3. Description of the ballast

- Quick programmed start: 1.2 second warm start, preheating the lamp electrodes; this enables the lamps to be switched on and off without reducing life.
- Intellivolt® 120–277V, 347–480V, or 277–480V: constant light independent of mains voltage fluctuations.
- End of Life Lamp (EOLL) protection: removes power to lamps upon lamp failure.
- Auto-restart cicuitry: eliminates the need to reset power mains after failed lamps are replaced.
- Low minimum starting temperature for cold applications.



A = 1.18" (30mm)
B = 1.70" (43.2mm)
C = 16.34" (415mm)
D = 16.70" (424.4mm)

Figure 4.1. T5 VHO and T5 HO 4 lamp case dimensions



A = 1.02" (26mm)
B = 1.18" (30mm)
C = 15.65" (397.5mm)
D = 16.34" (415mm)
E = 16.70" (424.2mm)

Figure 4.2. T5 HO 2 lamp case dimensions

4.4. Technical data for installation

Mains operation

Rated mains voltage	120–277V, 347–480V, and 277–480V
Tolerances for safety:	+/– 10%
Mains frequency	50/60 Hz
Power factor	>= 0.99

DC voltage operation (during emergency back-up)

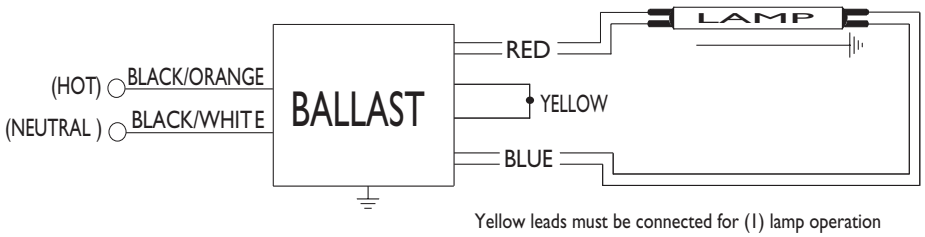
Because of the run up, T5 VHO and HO Extreme Temperature lamps (and therefore ballast) are not suitable in combination with emergency situations.

4.5. Switching cycle effects

The rated average lamp life of T5 lamps is negatively affected when the switching frequency is higher than the IEC cycle (3 hrs cycle: 2 hours and 45 minutes on, 15 minutes off).

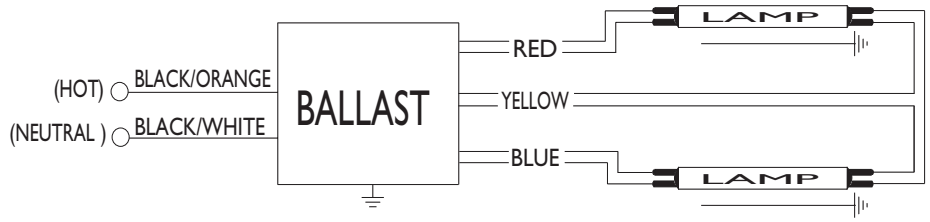
4.6. Wiring diagrams

Advance JOP-2S95-G T5 VHO Ballast



One-lamp operation

Advance JOP-2S95-G T5 VHO Ballast

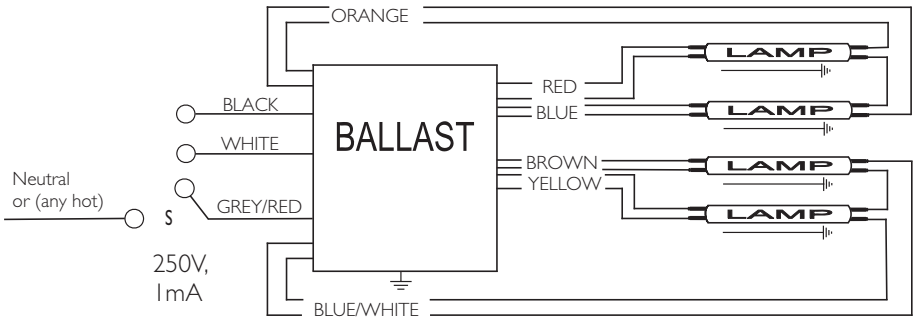


Two-lamp operation

Notes:

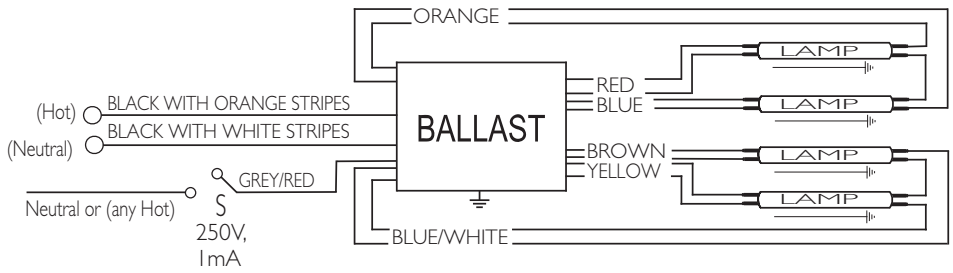
- Green terminal or ballast case must be grounded..
- Mount lamp within ¼" of grounded metal reflector.
- Max Voltage RED-YELLOW leads 340Vrms.
- Install in accordance with National and Local Electrical Codes.
- Use 18AWG Solid Copper Wire Rated >=600V. Strip Wire ⅜".

Advance ICN4S5490C2LSG T5 VHO Ballast



Four-lamp operation

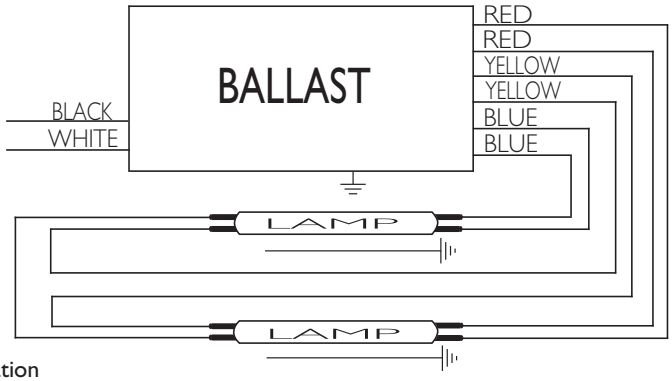
Advance HCN4S5490C2LSG T5 VHO Ballast



Four-lamp operation

Notes:
- Max. Voltage RED-YELLOW Leads 340Vrms.
- Insulate unused leads for 600V.
- Ballast case must be grounded.
- Mount lamps within ¼" of grounded metal reflector.

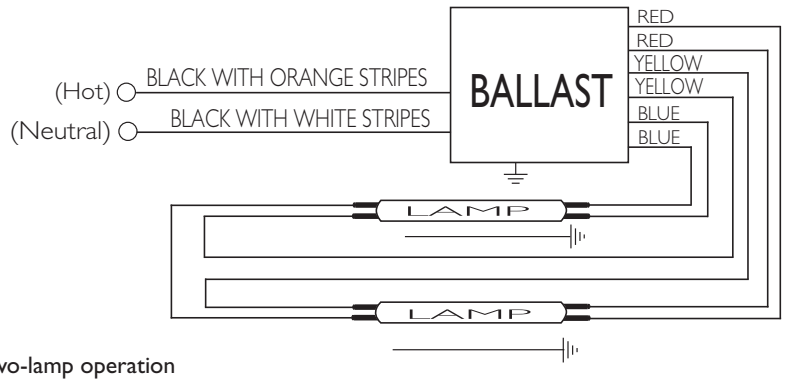
Advance ICN2S5490CWL T5 VHO Ballast



Two-lamp operation

Notes:
- Ballast case must be grounded.
- Mount lamps within ¼" of grounded metal reflector.
- Install in accordance with National and Local Electrical Codes.
- Use 18AWG Solid Copper Wire Rated >=600V. Strip Wire ⅜".

Advance HCN2S5490CWL T5 VHO Ballast



Two-lamp operation

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